CLAIMS

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- 2 creating a guest translation data structure to be used by a guest operating
- 3 system for address translation operations;
- 4 creating an active translation data structure based on the guest translation data
- 5 structure; and
- 6 periodically modifying content of the active translation data structure to
- 7 conform to content of the guest translation data structure, the content of the active
- 8 translation data structure being used by a processor to cache address translations in a
- 9 translation-lookaside buffer (TLB)
- 1 2. The method of claim 1 further comprising emulating functionality of the TLB
- 2 in response to an address-translation operation performed by the guest operating
- 3 system.
- 1 3. The method of claim 1 further comprising:
- 2 receiving control over an event initiated by guest software; and
- 3 evaluating the event to identify a cause of the event.
- 1 4. The method of claim 3 further comprising determining that the event is caused
- 2 by an inconsistency between the content of the active translation data structure and
- 3 the content of the guest translation data structure.

- 1 5. The method of claim 4 further comprising modifying one or more entries in
- 2 the active translation data structure that are associated with the event and do not
- 3 match corresponding entries in the guest translation data structure.
- 1 6. The method of claim 4 further comprising;
- 2 comparing the content of the active translation data structure with the content
- 3 of the guest translation data structure; and
- 4 modifying all entries in the active translation data structure that do not match
- 5 corresponding entries in the guest translation data structure.
- 1 7. The method of claim 3 further comprising:
- determining that the event is associated with a page fault that would occur
- 3 under normal operation of the guest software; and
- passing control over the event to the guest software.
 - 8. The method of claim 3 further comprising:
- determining that the event indicates an attempt of the guest software to
- 3 manipulate the TLB; and
- 4 modifying the content of the active translation data structure.
- 1 9. The method of claim 3 further comprising:
- determining that the event is associated with a page fault that would not occur
- 3 under normal operation of the guest software; and
- 4 modifying the content of the active translation data structure.

- 1 10. The method of claim 1 further comprising initializing the active translation
- 2 data structure by invalidating every entry in the active translation data structure to
- 3 emulate the TLB with no entries.
- 1 11. The method of claim 1 further comprising maintaining the active translation
- 2 data structure for each virtual machine running on a computer.
- 1 12. The method of claim 1 further comprising maintaining the active translation
- 2 data structure for each set of privilege levels that can be distinguished by page-based
- 3 protection.
- 1 13. The method of claim 3 further comprising:
- determining that the event is caused by an attempt of the guest software to
- 3 change a privilege level; and

determining whether the changed privilege level may affect page-based

- protection.
- .1 14. An apparatus comprising:
- a guest translation data structure to translate virtual memory addresses into
- 3 physical memory addresses, the guest translation data structure being managed by a
- 4 guest operating system;
- an active translation data structure to contain data derived from content of the
- 6 guest translation data structure, the active translation data structure being managed by
- 7 a virtual machine monitor (VMM); and

- 8 a translation-lookaside buffer (TLB) to store address translations derived from
- 9 the active translation data structure, the TLB being managed by a processor.
- 1 15. The apparatus of claim 14 further comprising the VMM to periodically modify
- 2 content of the active translation data structure to conform to content of the guest
- 3 translation data structure and to emulate functionality of the TLB in response to an
- 4 address translation operation performed by the guest operating system.
- 1 16. The apparatus of claim 15 wherein the VMM is to receive control over an
- 2 event initiated by guest software and to evaluate the event to identify a cause of the
- 3 event.
- 1 17. The apparatus of claim 16 wherein the VMM is to further determine that the
- event is caused by an inconsistency between the content of the active translation data
- 3 structure and the content of the guest translation data structure.
- 1 18. The apparatus of claim 17 wherein the VMM is to further modify one or more
- 2 entries in the active translation data structure that are associated with the event and do
- 3 not match corresponding entries in the guest translation data structure.
- 1 19. The apparatus of claim 17 wherein the VMM is to further compare the content
- 2 of the active translation data structure with the content of the guest translation data
- 3 structure and to modify all entries in the active translation data structure that do not
- 4 match corresponding entries in the guest translation data structure.

- 1 20. The apparatus of claim 16 wherein the event indicates an attempt of the guest
- 2 software to manipulate the TLB.
- 1 21. The apparatus of claim 16 wherein the event is associated with a page fault
- 2 generated by a processor in response to an operation performed by the guest software.
- 1 22. The apparatus of claim 14 wherein the active translation data structure is
- 2 maintained for each virtual machine running on a computer.
- 1 23. The apparatus of claim 14 wherein the active translation data structure is
- 2 maintained for each set of privilege levels that can be distinguished by page-based
- 3 protection.
- 1 24. A system comprising:
- a memory to store a guest translation data structure used by a guest operating
- 3 system for address translation operations and an active translation data structure
- 4 derived content from content of the guest translation data structure and managed by a
- 5 virtual machine monitor (VMM); and
- a processor, coupled to the memory, to contain a translation-lookaside buffer
- 7 (TLB), to cache address translations derived from the content of the active translation
- 8 data structure in the TLB, and to manage the TLB.
- 1 25. The system of claim 24 wherein the processor is to transfer control over a
- 2 particular event initiated by guest software to the VMM.

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- 1 26. The system of claim 24 wherein the memory is to store the active translation
 2 data structure for each virtual machine.
- 1 27. The system of claim 24 wherein the memory is to store the active translation
- 2 data structure for each set of privilege levels that can be distinguished by page-based
- 3 protection.
- 1 28. A computer readable medium that provides instructions, which when executed 2 on a processor, cause said processor to perform operations comprising:
- 3 creating a guest translation data structure to be used by a guest operating
 4 system for address translation operations;
 - creating an active translation data structure based on the guest translation data structure; and
 - periodically modifying content of the active translation data structure to conform to content of the guest translation data structure, the content of the active translation data structure being used by a processor to cache address translations in a translation-lookaside buffer (TLB).
- 1 29. The computer readable medium of claim 28 comprising further instructions
- 2 causing the processor to perform operations comprising:
- 3 receiving control over an event initiated by guest software;
- determining that the event is caused by an inconsistency between the content
- of the active translation data structure and the content of the guest translation data
- 6 structure; and

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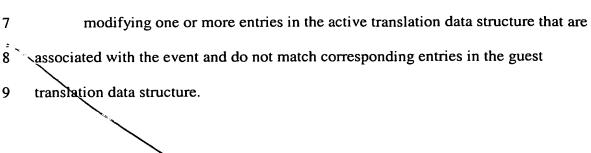
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- 1 30. The computer readable medium of claim 28 comprising further instructions 2 causing the processor to perform operations comprising:
- 3 receiving control over an event initiated by guest software;
 - determining that the event is caused by an inconsistency between the content of the active translation data structure and the content of the guest translation data structure; comparing the content of the active translation data structure with the content of the guest translation data structure; and
 - modifying all entries in the active translation data structure that do not match corresponding entries in the guest translation data structure.